Battery Protection Switch for 48 V

Preliminary Technical Datasheet B-samples

Revision 2.0 – October 12th, 2021

Battery Protection Switch

Description

Ultra-compact bidirectional solid state battery switch for disconnection of automotive 48V battery packages, designed as a replacement of conventional mechanic relays. Switch is able to protect battery circuitry from both sides during charging and discharging from overcharging or shorts. Low ohmic MOSFETs are attached on bulk aluminium substrates - by use of patented Anotherm aluminium substrates technology. Aluminium metal substrates act as high current carrying busbars and heat conductors simultaneously. This allows efficient cooling over busbar connection and baseplate. Customer specific designs, deviating from standard module (scalable Rdson, sensor integration, layout and dimensions) are possible.

Key features:

- **Integration of 6x 80 V MOSFETs (2 x 3 in antiserial configuration for bidirectional switching capability)**
- **Top side of MOSFETs wirebonded**
- **Integrated temperature sensors and gate resistors**
- **Interface pins for voltage measurement**

Module characteristics, configuration without molding

Absolute maximum ratings

Parameter	Conditions	Symbol	Value	Unit
Drain-source Voltage	V_{GS} = 0 V	V_{DS}	80	V
Gate-source Voltage		V_{GS}	0…+18	V
Operating Junction Temperature		T_J	-55 to +175	°C

Electrical characteristics

			min.	typ.	max.	
Static Terminal-Terminal on resistance, with 2 x 3 MOSFETs (customer adaptation possible)	V_{GS} = 10 V, I_D = 300 A, T_{amb} = 25 °C	$R_{DS,on,T-T}$	-	0.5	1.0	mΩ
Gate threshold voltage	V_{DS} = V_{GS}, I_D = 100 mA	$V_{GS(TH)}$	3	3.2	3.5	V
Total gate charge per chip	V_{DD} = 100 V, I_D = 100 A, V_{GS} = 10 V	Q_G		425	550	nC
Stray inductance module (Terminal-Terminal)		L_σ		12		nH
NTC-Thermistor rated resistance	T_C = 25 °C	R_{25}		10000		Ω
NTC-Thermistor resistance tolerance	T_C = 25 °C	R_{25}-Tol.		± 1		%
NTC-Thermistor power dissipation	T_C = 25 °C	$P_{diss-NTC}$			125	mW
NTC-Thermistor type	Vishay NTCS0603E3103FMT					

Thermal characteristics (simulated with 6SigmaET)

Thermal resistance, junction to water[1]	single side cooling, TIM	$R_{th\ JW}$	0.11	K/W

Thermal/electrical characterization (simulated with 6SigmaET)

Current	Tjmax	Time	Baseplate/ambient T
[A]	[°C]	[sec]	[°C]
75	55	cont.	55
147	119	300	118
209	117	60	116
250	83	10	81

Table 1: Simulated thermal / electrical performance. Experimental test confirmation will be shared later.

For more information, please contact KYOCERA AVX Components (Salzburg) GmbH.

Module

Parameter	Conditions	Symbol	Value	Unit
Material of module substrates			Aluminium	
Clearance	Terminal to terminal	$d_{clearance}$	2	mm
Creepage distance			2	mm
Terminal connection torque	Screw M6	M	5	Nm
Weight			43,0	g

Mechanical dimensions

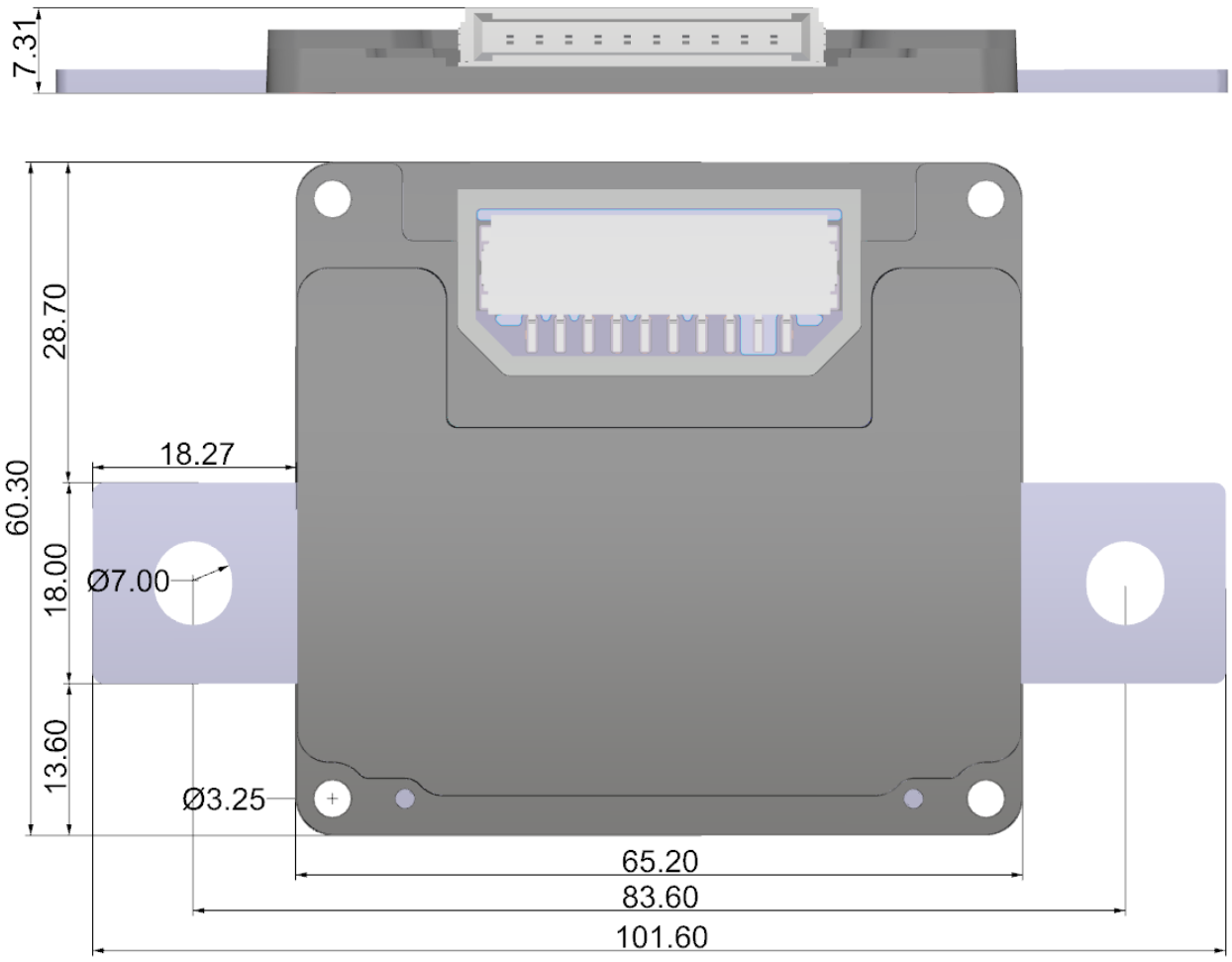


Figure 1 Mechanical dimensions of molded battery switch

Circuit diagram

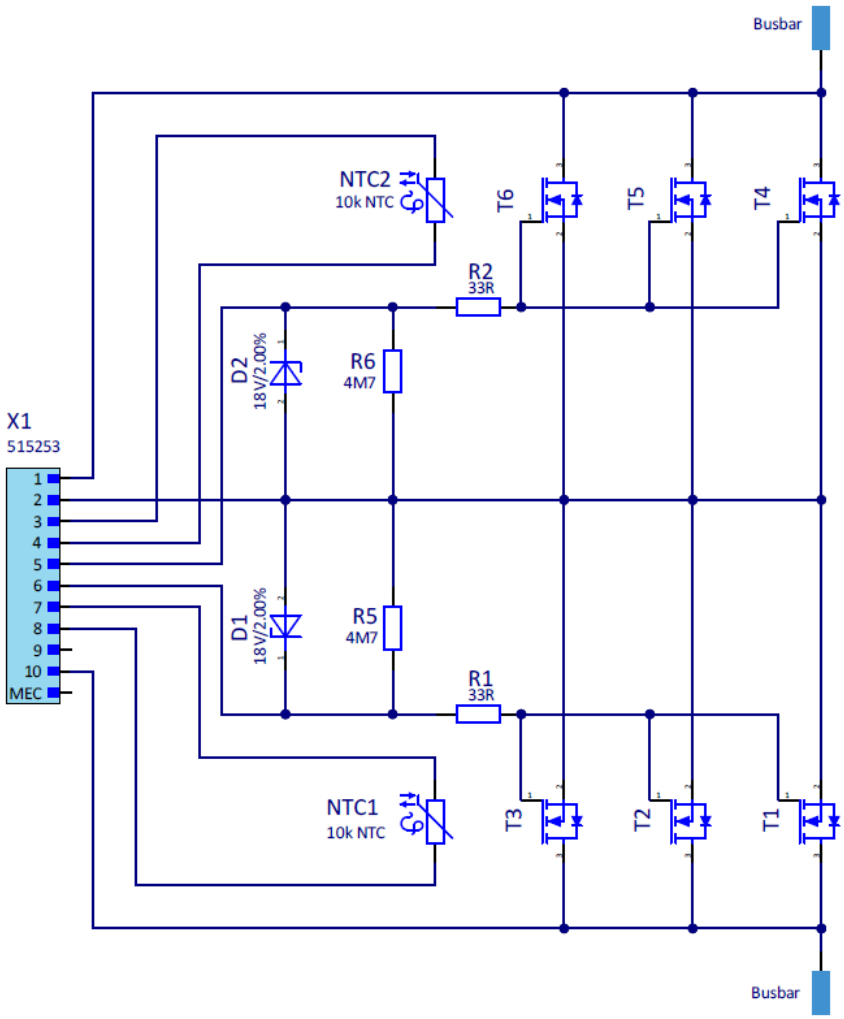


Figure 2 Circuit diagram

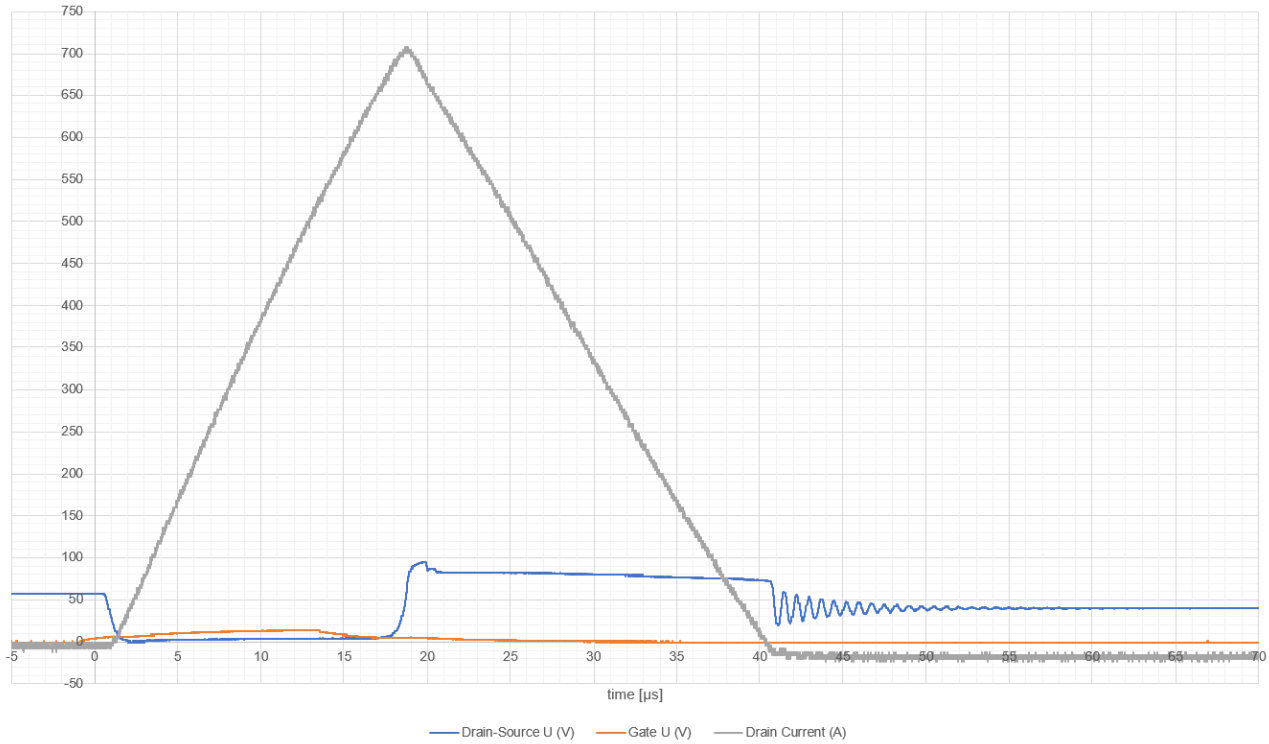
Pin Number	Symbol	I/O	Function
Drain 1 / Busbar	$I_{AC,T1}$	Input/output	Bidirectional current Terminal 1 (Bat +)
Drain 2 / Busbar	$I_{AC,T2}$	Input/output	Bidirectional current Terminal 2 (Load)
X1-1	$V_{DS,T1}$	Output	Drain 1, voltage sense connection
X1-2	V_S	Output	Source potential
X1-3	$T_{1,1}$	Output	NTC1 thermistor sensor lead 1
X1-4	$T_{1,2}$	Output	NTC1 thermistor sensor lead 2
X1-5	$V_{G+,T1}$	Input	Gate input plus Terminal 1
X1-6	$V_{G+,T2}$	Input	Gate input plus Terminal 2
X1-7	$T_{2,1}$	Output	NTC2 thermistor sensor lead 1
X1-8	$T_{2,2}$	Output	NTC2 thermistor sensor lead 2
X1-9	n.c.	n.c.	Not connected
X1-10	$V_{DS,T2}$	Output	Drain 2, voltage sense connection

Table 2: Pin description

Short Circuit Condition

Due to increased E/E requirements and increased integration of additional safety-relevant features in the electrical supply architecture of a vehicle, a semiconductor-based solution can offer significant advantages over a mechanical relay, especially since a higher switching speed is possible. Especially in the event of a short circuit, every microsecond counts here to ensure that the battery is disconnected safely. The main switch protects the supply circuit of a 48 V battery bidirectionally during charging and discharging in the event of overcharging or a short circuit. It is exactly for these two faults that a "thermal runaway" of the battery must be prevented under all circumstances.

Example of typical short circuit condition:



(t = 15 µs / U = 56 V)
High power TVS-Diodes were used in a protective circuit.

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